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CURRICULAR CONSIDERATIONS, OSWEGO.

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CURRICULUM STUDIES AT OSWEGO HAVE BEEN BASED ON A STUDY OF MAN AND HIS TECHNOLOGIES IN ORDER TO ANSWER BASIC QUESTIONS --(1) WHAT IS AND WHAT IS NOT MEANT BY THE NAME INDUSTRIAL ARTS, (2) WHAT SHOULD AND WHAT SHOULD NOT BE A PART OF THIS AREA OF STUDY, (3) WHAT RELATIONSHIPS EXIST BETWEEN INDUSTRIAL ARTS AND SIMILAR ACTIVITIES, AND (4) WHAT CRITERIA DO WE USE TO MEASURE THE VALIDITY OF WHAT WE ARE DOING. SEVERAL CURRICULUM EFFORTS ARE BASED ON THE PREMISE THAT INDUSTRIAL ARTS IS A STUDY OF MAN'S CREATIVE ENDEAVORS IN THE TECHNOLOGIES AND THAT THESE ENDEAVORS HAVE IDENTIFIABLE ORGANIZATION AND STRUCTURE. AN EDUCATIONAL PROGRAM OF INDUSTRIAL ARTS BASED UPON THE DISCIPLINES DERIVED FROM THE BODY OF KNOWLEDGE CREATED BY MAN IN THE TECHNOLOGIES PROVIDES A STRUCTURE WHICH IS EXTERNALLY STABLE AND INTERNALLY FLEXIBLE AND ADAPTABLE TO CHANGE. THE STRUCTURE ACCOMODATES PRESENT PROBLEMS AND PERMITS ESTABLISHMENT OF FRUITFUL PATTERNS OF INVESTIGATION FOR FUTURE DEVELOPMENTS. EVALUATION PERTAINING TO CLASSIFICATION SYSTEMS IN THE TECHNOLOGIES IS IN PROGRESS. WHAT WAS ONCE SEPARATED INTO DIFFERENT CATEGORIES IS NOW BEING INCORPORATED INTO A TOTAL SYSTEM SUCH AS A COMMUNICATION SYSTEM, A TRANSPORTATION SYSTEM, OR A PRODUCTION SYSTEM. FROM A STRUCTURE BASED ON CULTURAL UNIVERSALS IN THE TECHNOLOGIES, THE CURRICULUM PROBLEM CAN BE DELIMITED AND A SPECIFIC CONTENT RESERVOIR IDENTIFIED FROM WHICH OBJECTIVES, BASIC CONCEPTS, UNITS OF INSTRUCTION, PROGRAMS OF STUDY, AND METHODS OF IMPLEMENTATION CAN BE DETERMINED. (EM)

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CURRICULAR CONSIDERATIONS-OSWEGO

PAUL W. DEVORE

1967

INTRODUCTION. As a profession, we are critically examining our field of endeavor, and this is good. Our examination reveals that many of our memorized clichés in the areas of definition, objectives and methods are not valid. We have discovered we are continually on the defensive educationally because of a lack of relationship between what we say and what we do. The increasing complexity of man's creative endeavors in the technologies force us to re-examine our point of view, to look at our field differently.

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M O R E

Our curriculum efforts at Oswego have been based on a study of man and his technologies in an attempt to identify the discipline and knowledge base and common bodies of technological knowledge from which to derive curriculum structures and content.

We are searching for answers to rather basic questions. (1) What is and what is not meant by the name industrial arts? (2) What should and what should not be a part of this area of study? (3) What relationships exist between industrial arts and similar activities? (4) What criteria do we use to measure the validity of what we are doing?

OBJECTIVES. Several observations can be made which are relevant to the problem. One concerns objectives. Everyone believes objectives are important. However, there are distinct problems with objectives as used in education. Most are multiple and diverse and seldom have a direct effect upon what is taught. The premises upon which objectives are based are often not clear. Yet, we labor under the belief there is broad agreement on objectives and that the objectives are specific enough to be used for curriculum development and analysis. But they are not. Industrial arts objectives have concentrated attention on broad idealistic educational goals which are nice to have but which are almost useless for analysis and specification of program content because of vagueness and limitation of choice.

To progress, a distinction between broad educational objectives and the objectives of an identifiable knowledge field must be recognized. The objectives of an area of knowledge are derived from the discipline itself. The structure, content and methods or strategies of teaching are indigenous to and inherent in the discipline. Whereas educational objectives are unique to a given country or school system, the objectives of a given discipline are universal and are derived from the knowledge field itself. (2, p. 10)

DEFINITION. For years, we have practiced the definition, Industrial Arts is. My late colleague, Dr. Snygg,maintained the knowledge field was plural and that the definition should be: The Industrial Arts Are. This point of view recognizes the industrial arts as being concerned with several knowledge fields as are the sciences and the humanities. The function of the definition as an identification of the field of study, and not for delimination, is inherent in this point of view. The field of

study should define itself. What is the content and discipline base for the industrial arts?

STRUCTURE. Several current curriculum efforts at Oswego are based on the premise that the industrial arts are a study of man's creative endeavors in the technologies and that these endeavors have an identifiable organization and structure. Evidence is that this premise provides answers to our question with profitable results. Structure, content, objectives, methods, procedures, questions and problems can be derived from identifiable bodies of knowledge in the technologies. The structures evidence unifying themes, continuums of abstractions and theories and laws of technological progress which provide answers to the more critical questions relating to the study of the industrial arts.

RATIONALE. Concern for the development and structure of knowledge and the methods of the discipline of technology as a foundation for the derivation of curriculum in the industrial arts, rests on the following rationale. General Education, of which the industrial arts should be a

part, is concerned with common learnings based upon cultural universals. This is distinct from concern with specialities which consist principally of vocational callings. (10, p. 230).) According to Phenix, disciplined understanding is the foundation of general education. The content of general education is not "knowledge in general" which everyone has but authentic disciplined knowledge. It is general in that it is based upon cultural universals and relevant to all students and not to members of special groups. (7, p. 314).

THE PROBLEM. Any system developed must be productive in solving problems of curriculum design, provide a measure of excitement to students when they comprehend it, accommodate new advancements in the discipline and provide a continuum of scholarship and study from the most elemental concepts to advanced study at the terminal degree level and beyond.

The problem therefore becomes:

> Develop a curriculum structure based upon the study of man and his creative endeavors in the technologies which is externally stable and internally flexible and adaptable to change.

Two problems are involved: (1) The structure of the discipline itself and (2) The teaching of the discipline. Basic to the solution of

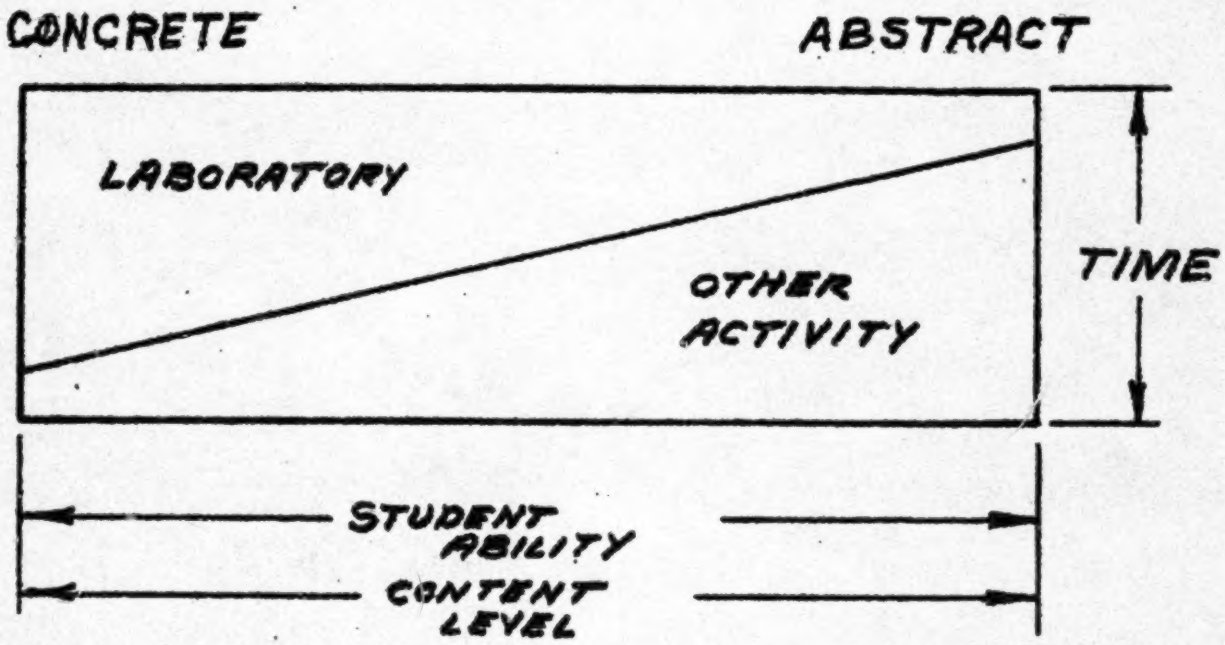
both problems is the identification of the universe of content in the technologies common to all cultures, however primitive or sophisticated. Progression in the analysis of the system of technology, encompassing technical and social- cultural elements, is from a general overall framework, to an identifiable knowledge structure, through the derivation of a taxonomy, to theories and laws of technological progress, From this system, content for the curriculum can be identified in the form of principles, concepts, units of instruction and courses of study.

All discipline and knowledge fields are schemes of unifications. They are attempts to order, classify and make intelligible vast areas of knowledge. As with objectives, two different categories exist; the discipline organization and the educational or curriculum organization. The discipline structure is arrived at by structural analysis which is concerned with the organization of things. The curriculum structure is developed through functional analysis relating to processes or types of activity. <u>This difference is important to note.</u>

Essentially, we have a need for two types of endeavors in our field; (1) those concerned primarily with the discipline of technology and its structure, taxonomy, theories and laws and (2) those concerned primarily with the educational process or curriculum and its structure, principles,

concepts, units of instruction, courses of study and learning environment. Both fields of study are closely interrelated and interdependent. In addition, the content universe involves both practical and theoretical elements and the knowledge field involves a continuum from concrete to abstract, thereby providing curriculum possibilities from the most elemental to the most advanced degrees.

Concern for the structure of the body of knowledge and level of abstraction of the body of content, permits the development of a curriculum structure combining various types of learning in relation to student ability and content level.



THE DISCIPLINE AREA: TECHNOLOGY. By looking at ourselves differently and by basing our curriculum endeavors in the industrial arts upon the discipline and structure of technology provides answers with profitable results.

First, we discover that technology, as a form of human knowledge, is identified by the character of thinking involved and that it is associated with tools- tools in the broad sense of the term. As Ayers (1, p. 112) points out, the character of technology is implicit not in the skill-faculty of the human individual but in the character of the tools, tools created by man. We also note that technology is a field of creative technical endeavor identifiable in all cultures. A common body of knowledge exists. Schmookler identifies technology as the social pool of knowledge of the industrial arts and states that any piece of technological knowledge available to someone anywhere is included in this pool by definition. (8, p. 1). As a function of human behavior it is significant to call attention to the fact that technology is problem centered and activity centered. Man's efforts in the technologies are his creative endeavors in the determination of what is to be. Thus, the character of the thinking required by man in his technological endeavors is determined by the nature of the problem. (4, p. 387).

Technology is an area of human knowledge, as are the sciences and the humanities, and is an endeavor common to all mankind at some level of sophistication. By emphasizing the relationship of man and technology, we are concerned with the human elements in the body of knowledge. The concern is with the modes of thinking, the problem solving and the solution of technical problems together with the social-cultural relationships involved.

It is important to recognize that technology is not science nor is it applied science. The nature and statement of the problems, the methodology and the goals are different. Progress in the technologies, according to Jarvie (p. 388), depends upon the increasing clarity with which technological problems are posed and by our improved ability to think ahead. The structure and character of technology are complex and interrelated and require analysis on the level of generalization rather than on the level of the skill-faculty of individuals. The complexity of technology results from the fact that the problems are environmentally centered and involve social-cultural components. Jarvie (4, p. 388) illustrates this point as follows:

> For example, much of our technology must be changed when we enter weightless or low gravity environments, just as big Tokyo buildings are different from big New York buildings on account of earthquakes.

Technology is concerned with the possible within given environments. Where science is concerned with the investigation of the whole universe and the discovery of the structure and laws which govern nature, technology is concerned with the creation of structures for specific, delimited purposes. The goal of pure science is the discovery of new knowledge. The goal of applied science is in understanding and extending this knowledge. Both deal with a reality that is given. Technology sometimes utilizes the knowledge and information of science and applied science in creating. At other times problems are solved without the benefit of science or applied science. As Skolimowski notes, (9, p. 374), "In science we investigate the reality that is given; in technology we create a reality according to our own designs."

The problems of science are dictated by the scientific field of investigation whereas those of technology are dictated not only by the environment but the social setting as well. (4, p. 388)

In our society, we cannot discuss intelligently economics without a knowledge of technical innovation, inventiom and the function of these elements in producing goods and services. The body of knowledge created by technology is vast, and inter-related to all fields of knowledge. Whereas, only a few in a society are directly involved in the pure sciences, all are involved, to some degree, in the creation and utilization of technology.

THE BODY OF KNOWLEDGE. Much effort has been directed by the profession in defining the industrial arts with little attention to identifying, ordering and classifying the body of knowledge on the basis of valid taxonometric principles. Machlup (5, p. 15) believes that attempts tp classify and order knowledge (in the sense of what is known) are often more enlightening than attempts to define it.

What base is appropriate from which to begin a classification analysis for the industrial arts? If industrial arts is to be a part of formal education, then formal education provides the base from which to determine the major areas of man's knowledge. Ten Hoor provides a logical answer based upon three questions. "Formal education, it can be said is concerned with three different though interrelated kinds of knowledge, each of which is man's answer to questions he has been asking himself since the beginning

of civilization. (1) What is there to be known about the external world and about those who live in it? (2) What use can we make of this knowledge? (3) What use ought we to make of this knowledge? (11, p. 423)."

The three questions identify respectively the distinct but interrelated knowledge fields of The Sciences, The Technologies and The Humanities, (11, p. 423).

Utilizing a basic criteria of structure, namely, simplicity, these three knowledge areas can be accepted as the foundation upon which to base further analysis and to derive a structure and content for the industrial arts. These fields of knowledge contain discipline areas which meet the criteria set forth by Phenix as being an identifiable organized tradition of men of knowledge and evidence fields of inquiry in which learning has been achieved in an unusually productive way. (7, p. 316-17).

They represent universal institutions created by man or universal endeavors engaged in by man. These universal institutions and endeavors make up the fabric of all progressive societies.

What universal institutions or endeavors are evident in the social pool of knowledge known as the industrial arts?

An historical and social analysis of man's endeavors in various cultures, for instance, establishes a number of man's universal technological endeavors.

We discover in our analysis that man in all stages of his technical development has been a builder, a communicator, a producer, a developer, a transporter, and an organizer. All progressive societies evidence three major areas of technology, namely, Production, including manufacturing and construction, Communication and Transportation together with supporting areas of research and development and an hierarchical division of labor. These are universal technological endeavors that have developed and progressed, establishing bodies of knowledge which have survived. Each has a specific structure, raises certain questions, has definite lines of progression and has been productive in an unusual way.

Each of these areas meets the criteria of a discipline and is a body of knowledge determined and agreed upon by specialists in the identified field.

An educational program of the industrial arts based upon the disciplines derived from the body of knowledge created by man in the technologies, provides a structure which is externally stable and internally flexible and adaptable to change. The structure accommodates present problems and enables the establishment of fruitful patterns of investigation for future developments.

Attacking the problem from the point of view of the disciplines of technology rather than from the vague and ambiguous education end, provides insights into the structure, objedtives, problems, methods and characteristics of thinking so necessary in curriculum development. Valid content selection rests upon a knowledge of the structure of the discipline and the analysis of activity and thinking patterns.

We discover as we investigate the structure of technology that continual evaluation is in progress pertaining to classification systems in the technologies. There is evidence that more and more of what was once separated into different categories, with separate functions and purposes. is now being incorporated into a total system; such as communication systems, transportation systems or production systems. Concern is with the "whole" and not only the component parts. For instance, the function of the knowledge area of communication concerns information dissemination, storage, retrieval and use. The methods of accomplishing this, whether in a man to man, man to machine or machine to machine system, vary with the task. Elements of radiant energy, printing, photography or graphic representation by man or machine are utilized to attain the most valid solution to a given communication program.

There are a number of reasons to engage in efforts in taxonomy or classification of knowledge areas, not the least of which is to obtain an accurate perspective of the content reservoir. Without a full perspective of the content reservoir a valid curriculum cannot be developed.

A taxonomy of the area of technology would:

1. Eliminate confusion and simplify the task of curriculum planning by providing a perspective of the relationships between the elements and the structure and order the knowledge area into specific categories, thereby, assuring a balanced allocation of content. (7, p. 250.)

2. Facilitate communication among the membership of the field of knowledge together with others such as administrators, curriculum specialists and scholars in related fields. (3, p. 10.)

3. Simplify understanding and economize intellectual effort by treating large numbers of different things as though they were identical in respect to the aspects by which the categories are defined. (6, p. 47-4, p. 36 and 42-13, p. 45.)

4. Provide a base for long term research and inquiry into the nature of the discipline area by ordering the area of knowledge in such a way as to reveal significant relationships and properties as well as the interrelationships between the elements of the structure. (3, p. 17.)

5. Provide a base for developing valid evaluation instruments by identifying elements of content to be evaluated.

6. Aid in identifying difficulty levels of content areas for establishing instructional sequences at different learning levels.

One test of an adequate taxonometric structure for the study of man and technology, in addition to the basic principles of taxonomy, is universalism. The structure must be applicable to technology in general and not indiginous to the technology of any one country or civilization. This is true, since no one country or civilization can claim credit as the sole creator or utilizer of technology. The structure must accommodate change.

The purpose of taxonomy is not to limit a field of knowledge arbitrarily but to ascertain its totality, together with the component elements and their interrelationships. Curriculum development thus follows the determination of the structure and its elements.

A taxonometric structure for the study of man and technology identifies three major areas of technological endeavor with which the industrial arts have been concerned to varying degrees. These areas represent the essence of the discipline, are consistent with major components in other technological classifications and provide for internal adaptability to change through the use of non-transient terms, The technical areas are:

AREA	FUNCTIONS
1. Production	Providing goods and services of economic value for man's needs and wants.
2. Communication	Providing information dissemination, storage, retrieval and use.
3. Transportation	Providing movement of man, materials, products and services.

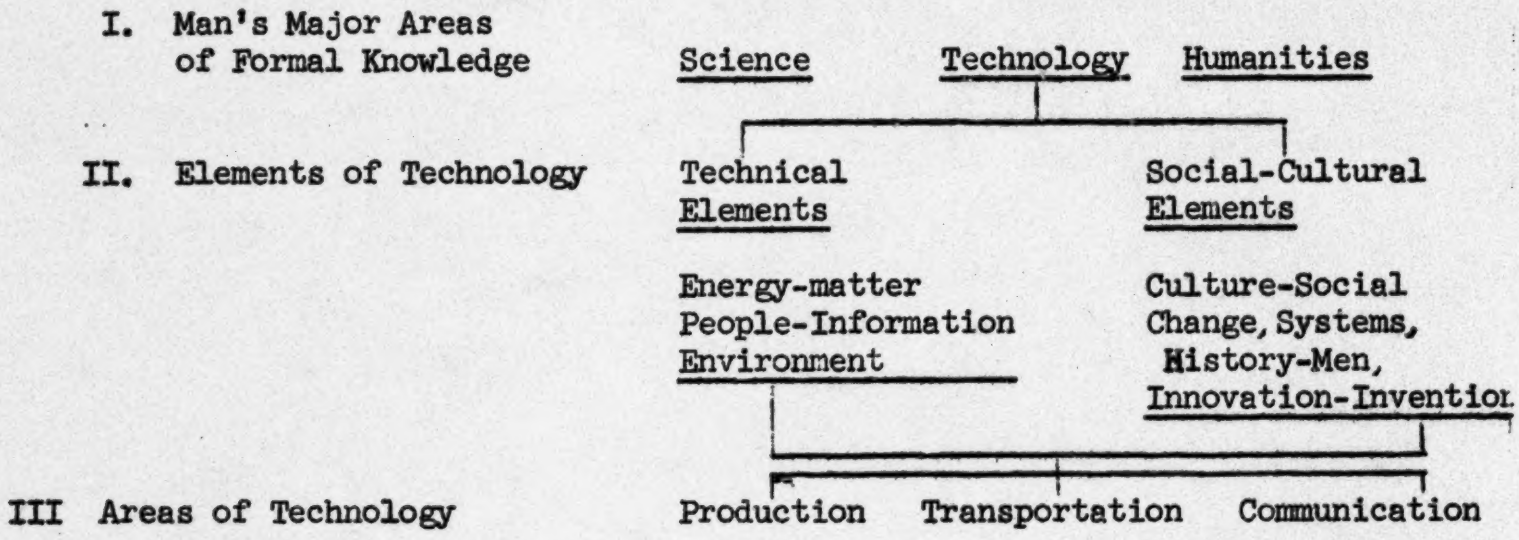
The technological areas of Production, Communication and Transportation are found in all cultures regardless of their stage of development. Hence, they meet the criteria of universalism.

A study of each of these physical areas indicates that they vary in their primary function, being unique discipline areas in their own right, and as with other discipline areas require their own taxonometric classification scheme. However, a close inter-relationship exists between the areas of production, communication and transportation and their elements, thereby meeting a requirement of structure.

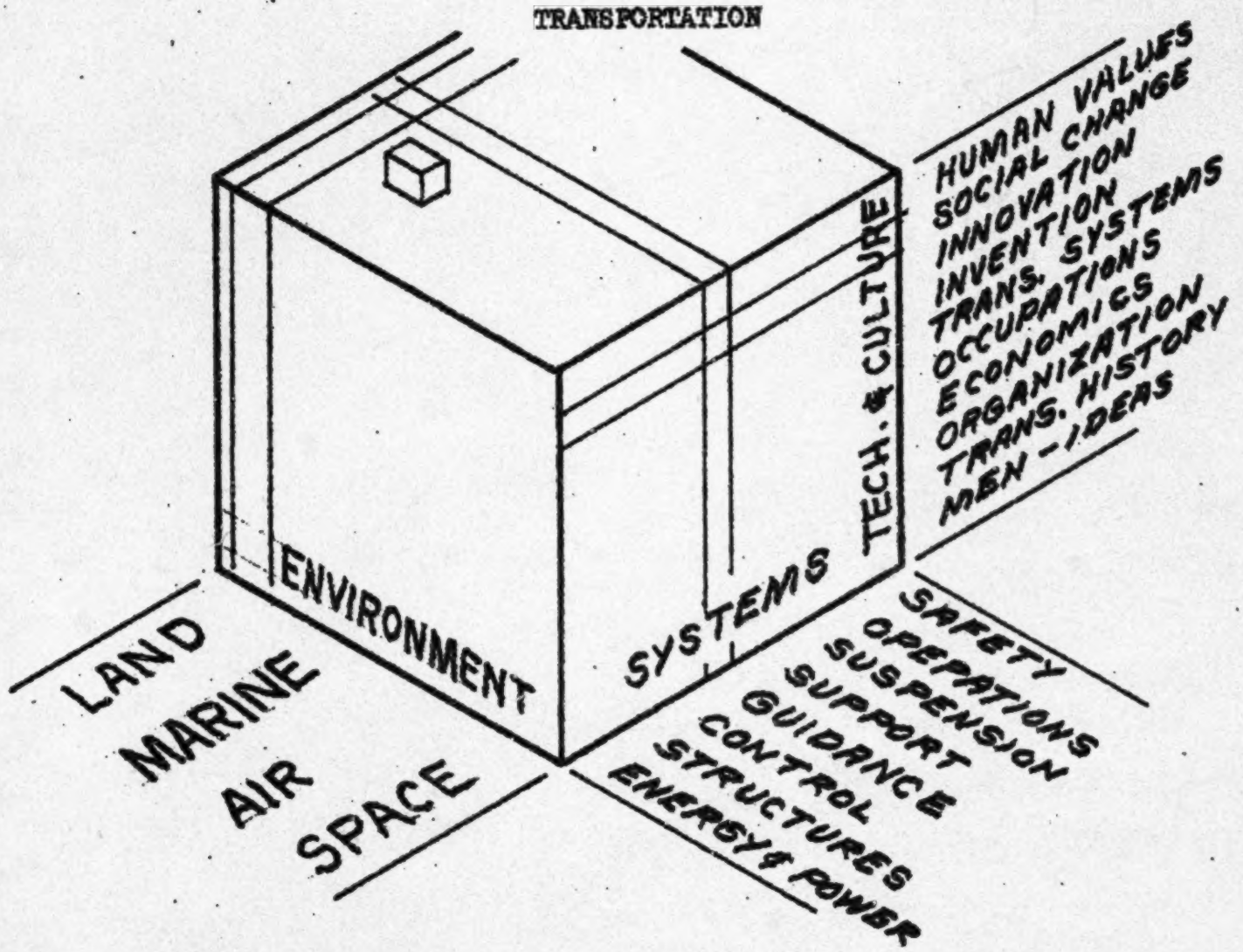
An analysis of each of man's major areas of technological endeavor identifies distinct technical and social-cultural elements. Each area has an identifiable taxonomy or knowledge classification together with interrelated elements common to all major areas of technical endeavor.

MORE

The logical progression of the main elements of the structure for curriculum investigations in the industrial arts develops as follows:



Each discipline areas has its own structure, problems and line of progression. The most valid structure or system will provide the best answers for the various contingencies. Transportation serves as an example.



The relationships between each environmental category as an element of the system is unique and involves a classification of the body of knowledge created in the solution of the transportation problems related to given environmental requirements and other criteria.

MORE

Curriculum designs being investigated indicate specific inter-relationships existing between the study of tranaportation technology and communication technology together with certain sciences as indicated in the diagram below.

Communication		Transportation				Natural Science
		Land	Marine	Air	Space	
Communication Graphics (Photography)	Energy & Power					Geography
	Guidance Control					Meteorology
Communication Electronics						
Radio (Navigation & Com.)	Support & Suspension					Astronomy
Radar	Structures					
Information Systems (Computers)	Operations & Safety					

Once a general structure has been developed which best meets the criteria of the discipline, the next step is to proceed to a definitive taxonomy from which content can be derived for curriculum development.

After the general framework has been developed, the four steps to curriculum development in the industrial arts based upon the creative endeavors of man in the technologies are:

1. Establishment of the content reservoir, a Taxonomy.
2. Establishment of the basic concepts and principles of the content area from the content reservoir.
3. Establishment of the units of content instruction based upon an analysis of the basic concepts and principles and the relationship of educational objectives to the objectives of the discipline.
4. Establishment of courses of study by the grouping of logical combinations of the units of instruction.

CONCLUSION: In evaluating the concept presented, there are several advantages which have accrued from such an approach in our study of the area of Transportation and Communication.

1. Criteria for content selection are established and curriculum development ordered and simplified. Optimum learning sequences can be planned by identifying complexity levels of content.
2. Flexibility and adaptability to change and internal consistency are intrinsic through the use of technological universals as a base. The overall structure is stable.
3. Rather than isolated and repetitive courses, programs of studies are inherent.

4. Teacher competency can be increased through the media of a specialization in a field of knowledge such as communication, transportation or production.

5. Teacher education programs at both the undergraduate and graduate levels would be improved, both from the point of view of the student and the faculty.

6. Utilizing the discipline and knowledge base would permit and require theoretical and laboratory study of technical programs through both the masters and doctoral levels. Advanced study programs, based on the content area in which one is expected to perform and not on peripheral or available content areas would become meaningful. The structure provides a base for a life time of learning and professional contribution through legitimate, recognizable specialization.

7. Communication would be improved in the profession.

8. New and more profitable research problems would become evident.

9. Both program and student evaluation would be enhanced and improved.

From a structure based on cultural universals in the technologies, the curriculum problem can be delimited and a specific content reservoir identified.

From the content reservoir, the several objectives of the industrial arts and general education can be determined and implemented.

Through a knowledge and understanding of the nature of the content, together with the stated and agreed upon objectives, the basic concepts,

units of instruction, programs of study and methods of implementation can be determined.

Without a definitive content base however, the goals of general education, to which the industrial arts should contribute, cannot be attained.

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